

INTERNATIONAL REFERENCE IONOSPHERE (IRI)

Task Force Activity 2000

-Report-

Dieter Bilitza

The annual IRI Task Force Activity was held at the Abdus Salam International Center for Theoretical Physics in Trieste, Italy from July 10 to July 14. The participants included J. Adeniyi (University of Ilorin, Nigeria), D. Bilitza (NSSDC/RITSS, USA), D. Buresova (Institute of Atmospheric Physics, Czech Republic), B. Forte (ICTP, Italy), R. Leitinger (University of Graz, Austria), B. Nava (ICTP, Italy), M. Mosert (University National Tucuman, Argentina), S. Pulinets (IZMIRAN, Russia), S. Radicella (ICTP, Italy), and B. Reinisch (University of Mass. Lowell, USA). The main topic of this Task Force Activity was the modeling of the topside ionosphere and the development of strategies for modeling of ionospheric variability. Each day during the workshop week the team debated a specific modeling problem in the morning during informal presentations and round table discussions of all participants. Ways of resolving the specific modeling problem were devised and tested in the afternoon in front of the computers of the ICTP Aeronomy and Radiopropagation Laboratory using ICTP's computer networks and internet access. The proceedings last year's Task Force Activity were published by S. Radicella (editor) as ICTP Report IC/IR/2000/4 in June 2000. A similar compilation is planned for the papers from this year's workshop.

(1) Bottomside Profile

The new representation of the electron density profile in the bottomside ionosphere is one of the most important contributions of the ICTP Task Force Activity (ITFA) to the International Reference Ionosphere (IRI) project. This new model will be included in the latest version of IRI. Ionosonde data from low and equatorial latitudes prepared specifically for the annual ITFA have resulted in a significant improvement of the IRI bottomside profile at magnetically equatorial latitudes. With the increasing availability of data from the current solar cycle maximum the ITFA effort now focuses on the accurate representation of the electron density profile for the high solar activities reached during solar cycle maximum. First results from the Jicamarca digisonde were reported by B. Reinisch and X. Huang (USA) indicating that the model values have to be increased during very high solar activity. Adeniyi (Nigeria) and Radicella (Italy) have studied the changes in bottomside parameters B0 and B1 during magnetic storms at equatorial stations and have investigated correlation with the vertical drift at the magnetic equator. Further studies are needed (including middle latitudes) to better understand and eventually model the effect magnetic storms have on the bottomside parameters B0, B1 and on the F1 layer thickness parameter D1. Theoretical simulations should be helpful and should be encouraged (S.-R. Zhang, China/USA) as well as studies based on incoherent scatter data (M.-L. Zhang, China).

The seasonal variation of B0 and B1 needs to be improved from the current step-like transition to a smooth annual variation. Data from the current solar maximum period need to be incorporated into the model table and this table should be checked for agreement with the B0, B1 models obtained for the Japanese MU radar (S.-R. Zhang, China/USA).

(2) Representing Ionospheric Variability

For many applications of ionospheric models the user needs to get an estimate of the possible deviation

of an actual value from a model value, e.g., if the model value is a monthly average then a user would want to know the standard deviation. For ionospheric parameters the use of medians and quartiles is recommended since it is less affected by out-laying values, as was shown again in presentations during this ITFA (Mosert, Argentina). The study of the variability of electron density can proceed in two ways: (a) focusing on the peak parameters ($hmF2$, $NmF2$) and profile parameters ($B0$, $B1$, $D1$), or (b) investigating the variability at each height. Adeniyi (Nigeria) and Mosert (Argentina) presented a paper on the variability of equatorial electron density profiles and Ezquer (Argentina) et al. studied electron density variability at fixed heights. Both approaches have their advantages and disadvantages. For an application that requires electron density profiles and their variability range, approach (b) would provide the better results, whereas it would be difficult to establish a variability range at each altitude using approach (a). If a specific application requires peak parameters, (a) is, of course, much better suited. It was decided to pursue both approaches and try to establish models for the variability of peak and profile parameters as well as for the variability at fixed heights.

Mosert, Ezquer (Argentina), Adeniyi (Nigeria) and Radicella (Italy) presented a series of papers on the variability of Total Electron Content (TEC). TEC is the most important ionospheric parameter for many applications, establishing a quantitative description of its quartile deviation from the monthly median is therefore of very high priority. From the presentation during this ITAF a first table of values looks as follows:

Daytime 20%

Sunrise/set 60%

Nighttime 40%

Winter 40-80%

Equinox 20%

Summer 20-50%

(3) Topside

Developing a new model for the topside electron density profile remains one of the most important goals of the annual ITFA. Pulinets (Russia) used Epstein functions to represent topside sounder data from Intercosmos 19 for quiet and disturbed conditions.

Reinisch (USA) et al. compared the TEC deduced from digisonde measurements with the TEC measured by the TOPEX satellite altimeter and find good agreement. Their comparisons with IRI-deduced TEC at Jicamarca again highlight the shortcomings of the current IRI topside electron density model. Bilitza (USA) presented a collection of electron density profiles (over 200,000) now available on CD-ROM. These are profiles deduced from the topside sounder measurements of Alouette 1, 2, and ISIS 1, 2. This database could be helpful in deciding which model to choose for the next edition of the IRI model. A number of model proposals have been presented during earlier ITFAs, e.g., Radicella (Italy) has combined ground ionosonde measurements, the DGR model, and Intercosmos 19 topside sounder data to produce a model representation of the whole ionosphere; The COST 251 model for the topside profile is based on work by Leitinger (Austria) and Titheridge (New Zealand); Bilitza (USA) is working

on a revision of the current IRI model based on Alouette and ISIS topside sounder data.

(4) Miscellaneous

One of the prime data sources for the Total Electron Content (TEC) is the fleet of GPS satellites. Several groups have developed algorithms for deducing TEC from the GPS measurements. Hernandez (Spain) et al. showed how information from IRI can help to improve this algorithm and provide better GPS-deduced TEC especially at low latitudes.

Nava (ICTP, Italy) discussed possible geometric errors in determining vertical TEC from Faraday measurements. Forte (ICTP, Italy) presented his approach to scintillation studies.

The next ICTP IRI Task Force Activity is planned for May 21 to 25, 2001. The primary focus of this ITFA will be the incorporation of a new model for the topside electron density profile into IRI. The ITFA will also continue to pursue improvements of the bottomside profile parameters especially for high solar activity, for the annual variation, and during magnetic storms. It is hoped that during the 2001 ITFA a first table of values can be established for the variability of ionospheric parameters.

- [Go to the IRI workshops page](#)
- [Go to the IRI homepage](#)